

[REDACTED]

#488

HELIOS 1 & 2
HOURLY AVERAGED ELECTRON PROTON
74-097A-10A
76-003A-10A

[REDACTED]

HELIOS-A

HOURLY AVERAGED ELECTRON-PROTON

74-097A-10A

This data set has been restored. There were originally four 9-track, 1600 BPI tapes written in Binary. There is one restored tape. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The original tapes were created on an IBM 360 computer and the restored tapes were created on an IBM 9021 computer. The DR and DS numbers along with the corresponding D numbers are as follows:

| DR# | DS# | D# | FILES | TIME SPAN |
|----------|----------|---------|-------|---------------------|
| ----- | ----- | ----- | ----- | ----- |
| DR004590 | DS004590 | D042969 | 1 | 12/10/74 - 03/31/75 |
| | | D048307 | 2 | 04/01/75 - 03/13/79 |
| | | D048306 | 3 | 01/01/79 - 06/21/80 |
| | | D048305 | 4 | 04/01/80 - 12/31/80 |

HELIOS-B

HOURLY AVERAGED ELECTRON-PROTON

76-003A-10A

This data set has been restored. There were originally three 9-track, 1600 BPI tapes written in Binary. There is one restored tape. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The original tapes were created on a 360 computer and the restored tapes were created on an IBM 9021 computer. The DR and DS numbers along with the corresponding D numbers are as follows:

| DR# | DS# | D# | FILES | TIME SPAN |
|----------|----------|---------|-------|---------------------|
| ----- | ----- | ----- | ----- | ----- |
| DR004855 | DS004855 | D042970 | 1 | 01/15/76 - 03/31/76 |
| | | D048309 | 2 | 01/15/76 - 04/05/78 |
| | | D048308 | 3 | 04/01/78 - 03/08/80 |

| <u>REQ. AGENT</u> | <u>RAND NO.</u> | <u>ACQ. AGENT</u> |
|-------------------|-----------------|-------------------|
| BER | V0077 | HKH |
| DEW | V0142 | HKH |

HELIOS A AND B
 HOURLY AVERAGED ELECTRON - PROTON
 74-097A-10A
 76-003A-10A

This data set consists of 7 data tapes. These tapes are 1600 BPI, 9 track, binary and were created on a PDP 11/40 computer. The time spans, D#'s and C#'s are as follows:

74-097A-10A

| <u>D#</u> | <u>C#</u> | <u>TIME SPAN</u> |
|-----------|-----------|---------------------|
| D-42969 | C-21458 | 12/10/74 - 03/31/75 |
| D-48305 | C-22405 | 04/01/80 - 12/31/80 |
| D-43306 | C-22406 | 01/01/79 - 06/21/80 |
| D-48307 | C-22407 | 04/01/75 - 03/31/79 |

76-003A-10A

| | | |
|---------|---------|---------------------|
| D-42970 | C-21459 | 01/15/76 - 03/13/76 |
| D-48308 | C-22408 | 04/01/78 - 03/08/80 |
| D-48309 | C-22409 | 01/15/76 - 04/15/78 |

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BLATT -2-

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Dr. J. Vette

Code 601

NASA-Goddard Space Flight Center

NSDC

Greenbelt, Maryland 20771

U.S.A.

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(BLZ 20580001) 4104449

| IHRZEICHEN | IHRE NACHRICHT VOM | UNSER ZEICHEN | DATUM |
|------------|--------------------|---------------|------------------|
| | | KE/KRI/sch | 11 December 1980 |

| Item | Type | Description |
|------------|------|--|
| 1 | I | YEAR ((YEAR - 1974)*366+DOY)*24+HOUR |
| 2 | I | DOY |
| 3 | I | HOUR |
| 4 | I | MINUTE |
| 5 | I | LENGTH OF THE TIMEINTERVAL IN MINUTES (60) |
| 6 | I | IMPORTANT FOR TAPE GENERATION, ONLY |
| 7 | I | SEQUENCE NUMBER OF THE SOURCE TAPE |
| 8 | I | REEL NUMBER OF THE SOURCE TAPE |
| 9 | I | 0-HELIOS 1, 1-HELIOS 2 |
| 10 | I | 1-E8 MODE A, 0-E8 Mode B |
| 11 | I | NOT DEFINED |
| 12-14 | R | RATE, F-DATA ENERGY CHANNEL 1, SECTOR 1, ELECTRONS |
| 15 | R | CORRESPONDING MEASURING TIME < 3600/256 SEC |
| 16 | R | 15 REPETITIONS OF 15-16 FOR THE ENERGY CHANNELS 2-16, SECTOR |
| 17-46 | R | 47-56, R 57-1038, R 1039, 1040, R 1041-1070, R 1071-1102, R 1103-1104, R 1105-1106, R 1107-1108, R 1109-1110, R 1110-1116, I |
| 47-56 | R | 15 REPETITIONS OF 15-52 FOR THE SECTORS 2-16 |
| 57-1038 | R | SAME AS 15-526 FOR PROTONS |
| 1039, 1040 | R | RATE, MEASURING TIME < 3600/32 SEC FOR R-ELECTRONS, SECTOR |
| 1041-1070 | R | 15 REPETITIONS OF 1039-1040 FOR THE SECTORS 2-16 |
| 1071-1102 | R | SAME AS 1041-1070 FOR PROTONS |
| 1103-1104 | R | W4 |
| 1105-1106 | R | W23 |
| 1107-1108 | R | W24 |
| 1109-1110 | R | W44 |
| 1110-1116 | I | NOT DEFINED |

Dear Dr. Vette:

By separate mail we are sending you two HELIOS-E8-Tapes with the following content:

The E8-Tapes contain hourly averages of all available E8 science data measured in E8-mode A (MNFT-FB W76-14, 1976; ESA-TR-390-Revised, 1977) and the corresponding measuring times.

Tape Structure

Each tape contains one file with data blocks of fixed length (4464 bytes). The end of a tape is marked by two consecutive end-of-file marks. The density is 1600 bpi.

Data-Block Content

Each item within one data block has a length of 4 bytes. The integer items (I) are of two's complement (important only to identify zero). The real times (R) have the following format:

$\begin{matrix} 0 \\ 7 \end{matrix}$

$\begin{matrix} S \\ X_1 \\ X_2 \\ H_1 \\ H_2 \\ H_3 \\ H_4 \\ H_5 \\ H_6 \end{matrix}$

$X_1, H_i = \text{hexadecimal numbers}; X_1 < 8, H_1 > 0$

Negative rates indicate non available or invalid source data.

The sign bit S indicates whether the value is positive (0) or negative (1). The absolute value is

$0 \cdot H_1 H_2 H_3 H_4 H_5 H_6 \times 10^{X_1} X_2 - 40$ in hexadecimal notation.

The 1116 items are described in the following table (next page).

J. Vette
(Dr. E. Keppler)

Max-Planck-Institut für Aeronomie
Institut für Stratosphären-Physik
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Project HELIOS
Experiment 8
April 1974

DESCRIPTION OF EXPERIMENT 8
"ELECTRON-PROTON-DETECTOR"

CONTENTS:

1. GENERAL, PHYSICAL PROPERTIES
2. DETECTION PRINCIPLE
3. OPERATIONAL PRINCIPLES, MODE A
4. DETERMINATION OF "m"
5. OPERATIONAL PRINCIPLES, MODE B
6. INFILIGHT CALIBRATION
7. DATA FRAMES
8. HOUSEKEEPING AND ENGINEERING DATA
9. COMMANDS

1. GENERAL, PHYSICAL PROPERTIES

Experiment 8 utilizes an inhomogeneous magnetic field of about 800 Gauß normal to the sensor axis (which is the center line of the cone of acceptance) in order to separate positively and negatively charged particles. Fig. 1 shows the principle.

Electrons are bent away from the center line and are being detected by 4 semiconductor detectors of different thicknesses. They are arranged such as to allow the detection of electrons from 20 keV up to more than 1 MeV.

Protons of energies above 40 keV are not affected by the small scale magnetic field and proceed to a proton telescope of 2 detectors, mounted opposite to the entrance aperture. Positrons are bent opposite to the electrons and may be detected by a detector at that place. This one is also backed by a "background detector" to form a coincidence/anticoincidence device in order to reduce cosmic ray background contribution to the positron channel. Table 1 summarizes the energy ranges of the sensor system. The geometrical factor of the sensor system is about $0,1 \text{ cm}^2 \text{ ster}$ for e^- and p , assuming isotropic angular distribution.

Fig. 2 shows two cross sections of the sensor system. The system looks rather complicated; this is due to constructional elements introduced in order to resolve the thermal problem: semiconductor detectors reduce their noise level considerably if temperature is lowered to about 0°C , the slope then flattens as one goes to even lower temperatures. A design goal for this experiment was therefore to get operational temperatures in the 0°C range. On the other hand temperature analysis predicts for the experiment aperture, protruding through the S/C skin up to 180°C (at perihel). Therefore two measures were taken: (a) The experiment was coupled through a large base plate to the S/C. Honeycomb structure, which is directly under a thermal control louvre system. So the louvre system is supposed to control the temperature of the base plate. All detectors are mounted rigidly to the base plate through massive material. (b) All other structure, not to be cooled is thermally

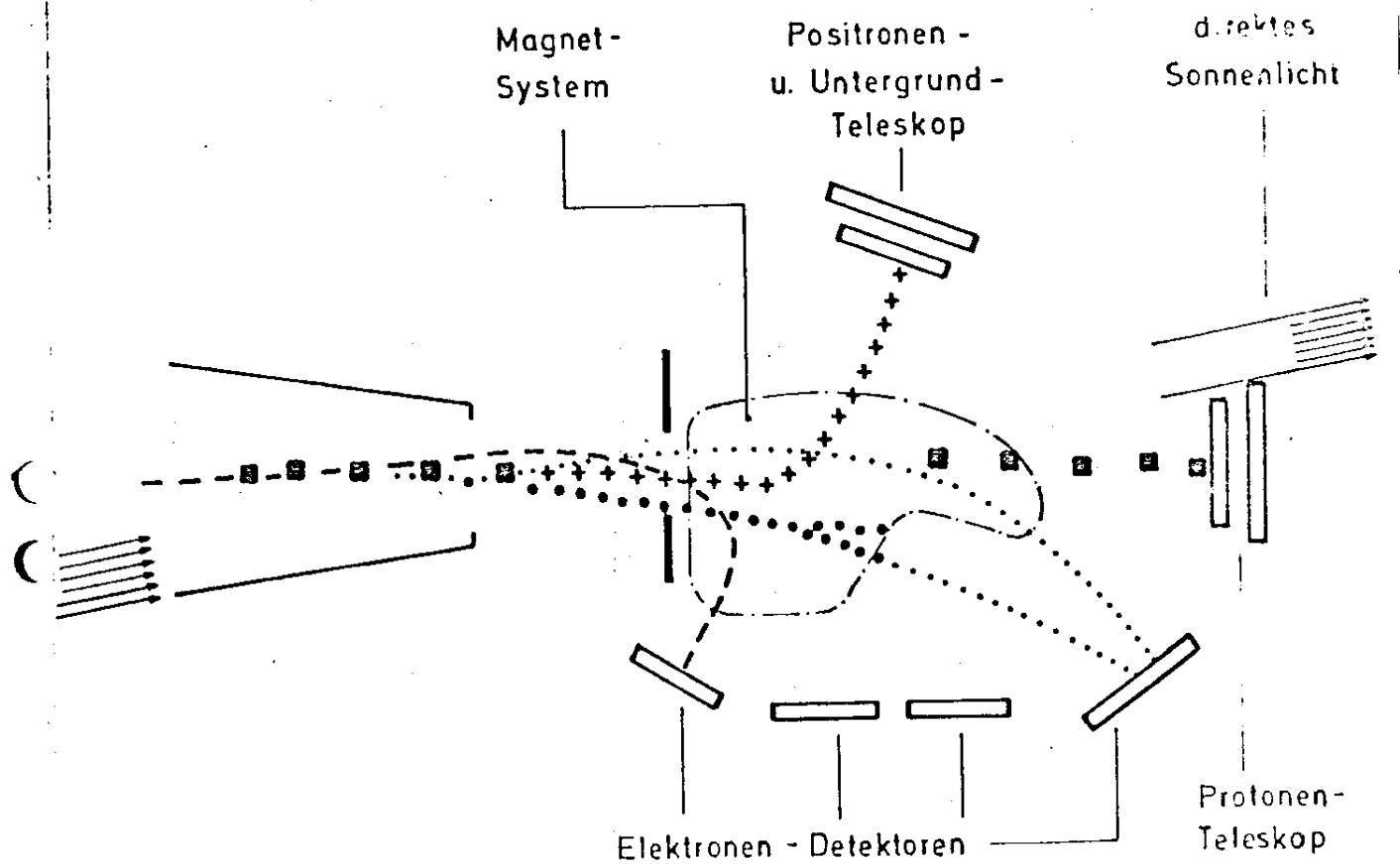
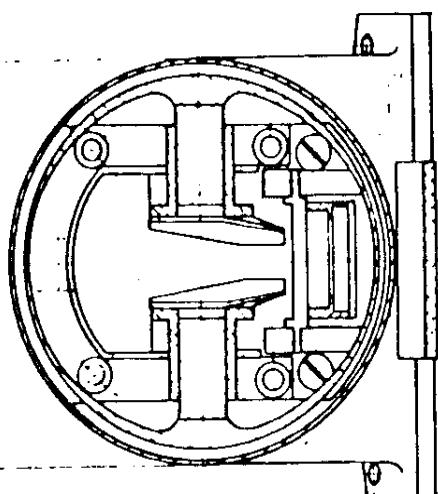


Fig. 1



Schnitt A-A

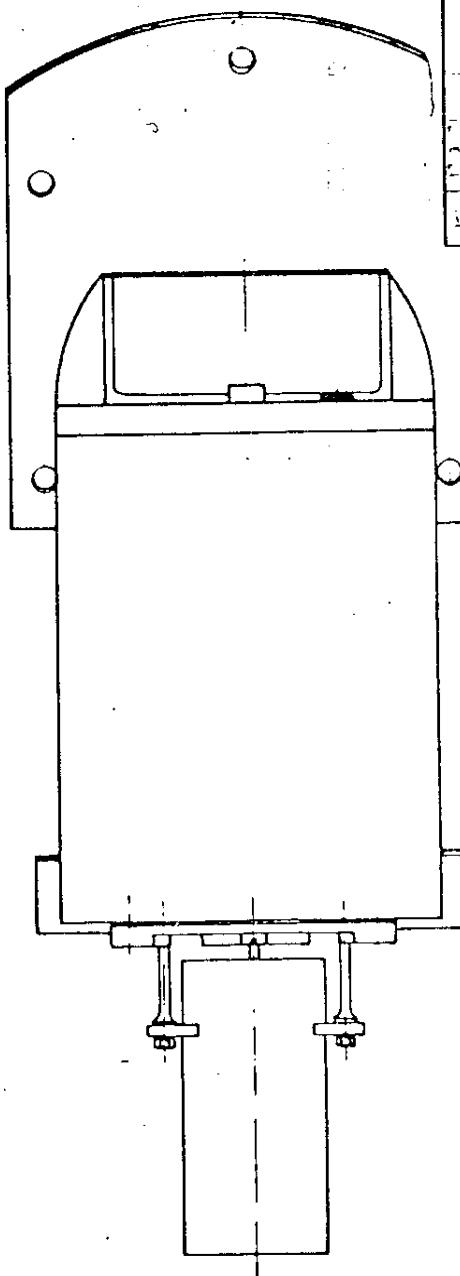
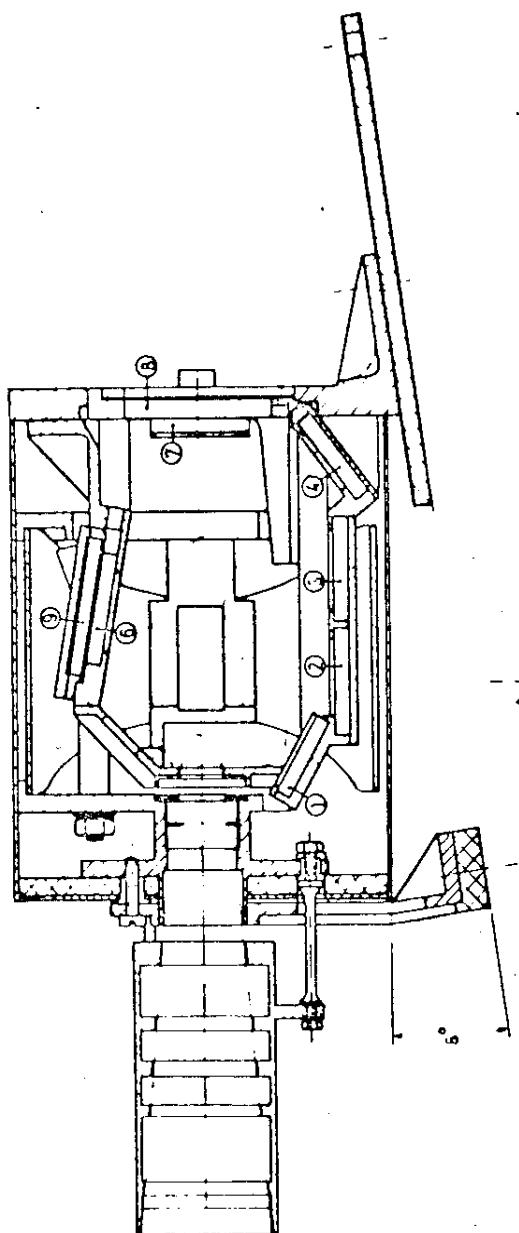


Fig. 2

Institut für Strahlungsmesstechnik
am Max-Planck-Institut für Aeronomie
Lindau/Hess

M 1.1

Struktur E 8 A Sensorteil

decoupled from that system through titanium bolts and teflon isolation. Tests has shown, that the system should work as expected.

In order to keep the magnetic stray field down at the required level, the magnets have been surrounded by a large magnetic flux joke. Finally a mu-metal-can surrounds the whole system.

TABLE 1: DETECTORS AND ENERGY RANGES.

| Detector No. | Area (mm ²) | Thickness (μ) | Particle Type | Energy Range |
|--------------|----------------------------|------------------------|----------------|--------------|
| 1 | 100 | 300 | e ⁻ | 20- 60 keV |
| 2 | 200 | 300 | e ⁻ | 50- 300 keV |
| 3 | 200 | 1000 | e ⁻ | 200- 700 keV |
| 4 | 250 | 500 | e ⁻ | > 600 keV |
| 6 | 200 | 1000 | e ⁺ | 150- 500 keV |
| 7 | 125 | 300 | p | 50-1000 keV |
| 8 | 300 | 300 | p | > 6 MeV |
| 9 | 300 | 300 | background | |

The experiment is split up into three boxes:

E8A Sensor System

E8B Digital Electronic Box

E8C Analog Electronic Box

All electrical interface to the S/C is made through E8B. Fig. 3 shows, how the experiment is mounted into the S/C. E8A is inclined against the S/C mounting deck by about 8° in order to avoid direct sunlight hitting the detectors. As at perihel the straylight within the experiment is very high, a requirement on the angular distance of the experiment relative to the sun sensor has been made, in order to have the sectorization (see below) such that sector switching is done prior and after sun passage (only one sector possibly deteriorated).

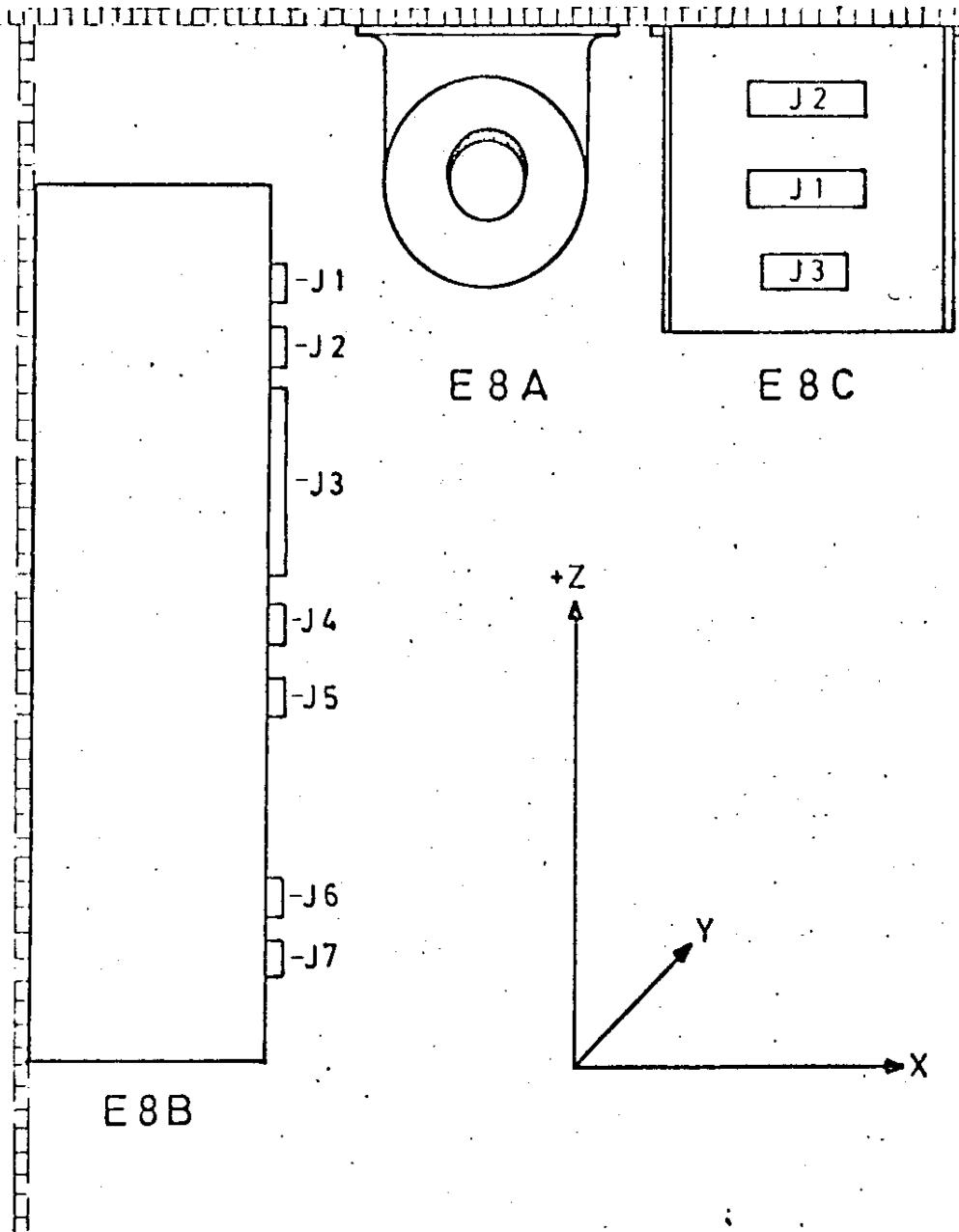


Fig. 3

| | | | | |
|---|--------|--|---|----------------|
| nez. | 5.5.77 | | Institut für Stratosphärenphysik am Max-Planck-Institut für Aeronomie Lindau/Harz | Werkstoff: |
| Stückliste Nr.: | | | | Zeichnung Nr.: |
| Einbauanordnung des Exp. 8 im S/C ab PT | | | | |

2. DETECTION PRINCIPLE

Fig. 4 shows a block diagram, drawn in order to show the detection principle, neglecting details for clearance. For energy analysis a 3 bit PHA is used. As the energy range of electrons, hitting a particular electron detector (Table 1) is limited, the amplification of each amplifier following a particular detector is adjusted such that its energy range is projected towards the 3 bit analyzer. Each amplifier is followed by a discriminator, adjusted for the lowest energy to be recorded. Thus a signal from this discriminator denotes the line on which a pulse has appeared. Line identification and pulse height information of a particular particle (e^-) entering the sensor are now used to form the address of a memory cell to which one pulse is added (each cell allows for 19 bit storage). Hereby the following scheme (Table 2) is utilized:

TABLE 2: ENERGY CHANNEL FORMATION.

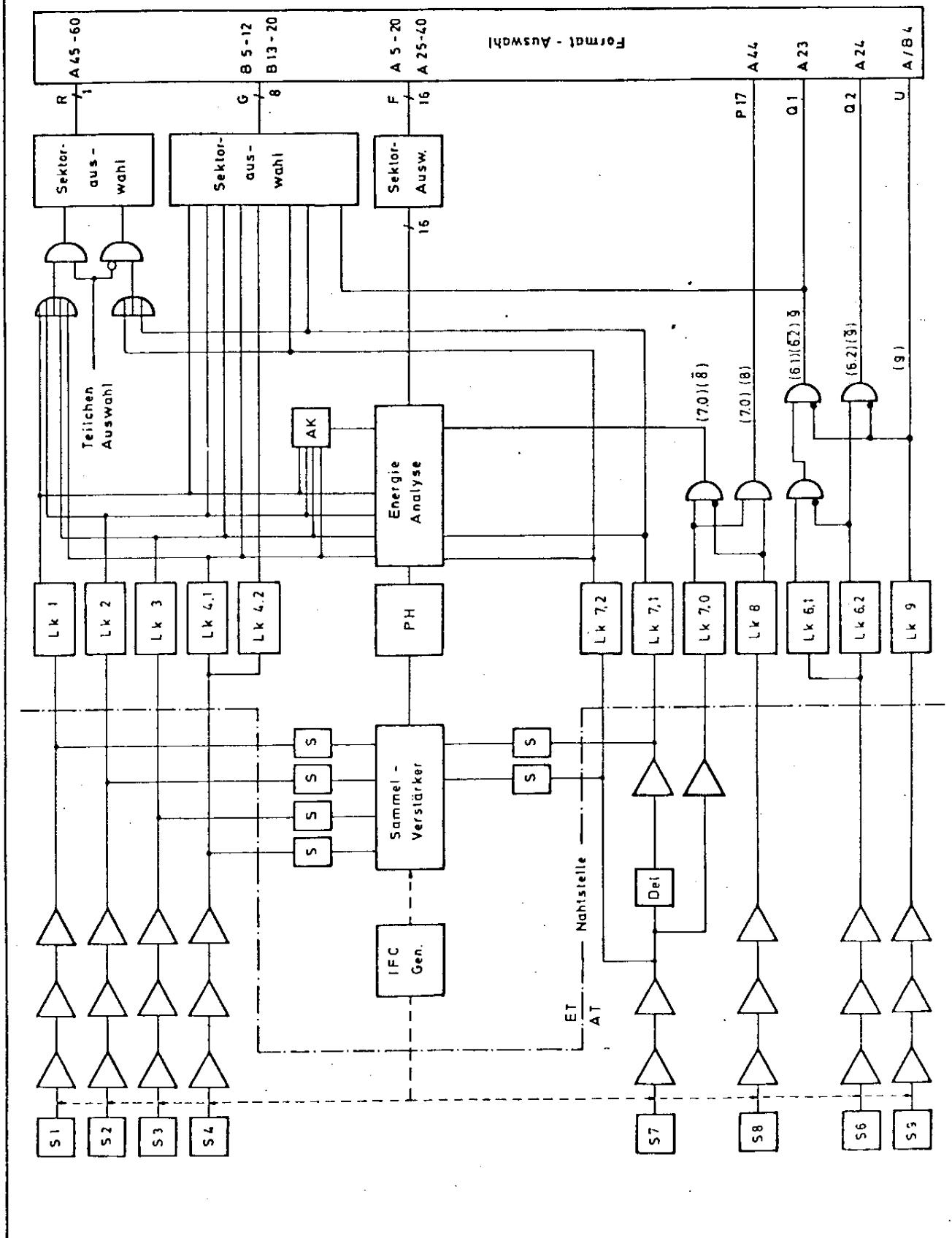
| Pulse Height window Line Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--|----|----|----|----|----|----|----|----|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 3 | 10 | 11 | 12 | 13 | 14 | 15 | 15 | 16 |
| 4 | -- | -- | -- | -- | 16 | 16 | 16 | 16 |

Numbers in the matrix indicate pulse height channel.

By this method the 3 bit PHA is actually used as a 4 bit PHA. Table 3 describes energy allocation (typical values, slightly different for each unit). In order to avoid confusion, the energy analysis is blocked for two or more particles appearing within 0,5 μ sec on different lines by utilizing an anticoincidence veto signal.

Fig. 4

Blockdiagramm
zur
Datenabtrennung



Proton detection utilizes another scheme: The amplifier has two outputs, both differ in amplification level by about a factor of 7. Each output is monitored by a 0,6 Volt discriminator. The higher amplified branch (lower energy branch) is further splitted into two lines: one is delayed by 1 μ sec, the other not. The latter (L 7.0) is used to form together with the S8 sensor a coincidence veto signal, which blocks energy analysis. The former (L 7.1 and L 7.2) is fed towards the PHA (3 bit). The signal on the delayed line is being analyzed if no pulse on L 7.2 has appeared. So also here the PHA is used as 4 bit device. Again the line identification signal is used to allocate the memory address (1 out of 16) (F-data). Energy channels are shown in Table 3.

There is only one PHA which is shared in time multiplex by electrons and protons. In addition the output pulses of the delayed proton channel and of the signal (L1+L2+L3+L4) from the electron detectors are separately counted to form the energy integral information (R-data). Also the coincidence rate of the proton telescope (L7,L8) is recorded.

For positron detection sensor 6 is monitored by two discriminators (L, H). The background detector rate (B) is also recorded. The positron information transmitted to ground is then (L \bar{H} \bar{B}), H and B. L and H are adjusted to the range within which particles may hit the detector 6 (see Table 1).

TABLE 3: ENERGY CHANNELS (keV).

| Energy Channel | Electron-Detector No. | | | 4 * | Protons *** |
|----------------|-----------------------|---------|---------|------|-------------|
| | 1 | 2 | 3 | | |
| 1 | 17-22 | | | | 21- 27 |
| 2 | 22-28 | | | | 27- 35 |
| 3 | 28-36 | | | | 35- 44 |
| 4 | 36-46 | | | | 44- 56 |
| 5 | 46-58 | | | | 56- 71 |
| 6 | 58-74 | 58- 74 | | | 71- 90 |
| 7 | 74-92 | 74- 93 | | | 90-110 |
| 8 | > 92 | 93-120 | | | 110-137 |
| 9 | | 120-153 | | | 137-174 |
| 10 | | 153-201 | 153-201 | | 174-222 |
| 11 | | 201-248 | 201-250 | | 222-279 |
| 12 | | 248-298 | 250-300 | | 279-353 |
| 13 | | > 298 | 300-412 | | 353-444 |
| 14 | | | 412-525 | | 444-563 |
| 15 | | | 525-835 | | 563-677 |
| 16 | | | > 835** | >170 | 677-~6000 |

* Energy loss in detector 4, equivalent to $E > 600$ keV, defined by magnetic system.

**Efficiency at that energy < 10 % of that in channel 15.

***Energy loss in front detector. 21 keV equivalent to about 50 keV kinetic energy.

3. OPERATIONAL PRINCIPLES, MODE A

The sensor system has an aperture equivalent to 10° half angle. In order to realize its directional capabilities, data are collected by sectorization into 16 sectors. Sector 1 starts always with the "see-sun-pulse". As the S/C rotates around the sun, the sector pattern is always synchronized to the see-sun-pulse. For obtaining directional data in a reasonable time, we use the integral rates of electrons or protons, and count them for 1/16 spin revolution into register 1, during sector 2 in register 2 etc. After 1 spin revolution we again continue to count in register 1, etc., until m spin revolutions are completed. At that time the contents of the 16 registers are reduced into 8 bit words (quasilogarithmically compressed) and stored in buffer registers. For this operation we require 2 sectors, which is a deadtime during which no measurements will be performed. With the next sector we again start counting in the same manner, however protons, if during the former cycle electrons have been measured. Again m revolutions will be used as measuring time, however, the direction in space will be maintained (sector 1 starts with the see-sun-pulse, even if measuring time starts with sector 3 or 11). By this method we obtain the directional flux of electrons and protons resolved into 16 directions in a rather short time (R-data).

In parallel, for the same time energy spectra are being obtained, also resolved into 16 sectors, but at a lower rate: During the first m revolutions energy spectra, say, for electrons, are obtained in sector 1 and 9. During the second m revolutions electron energy spectra from sector 2 and 10 are obtained. After 8 such measuring times we have energy spectra from electrons from 16 different directions. In the next 8 measuring cycles we do the same for protons, etc. We call this category of data F-data. The scheme is illustrated in Table 4, details of electronics are shown in Fig. 5.

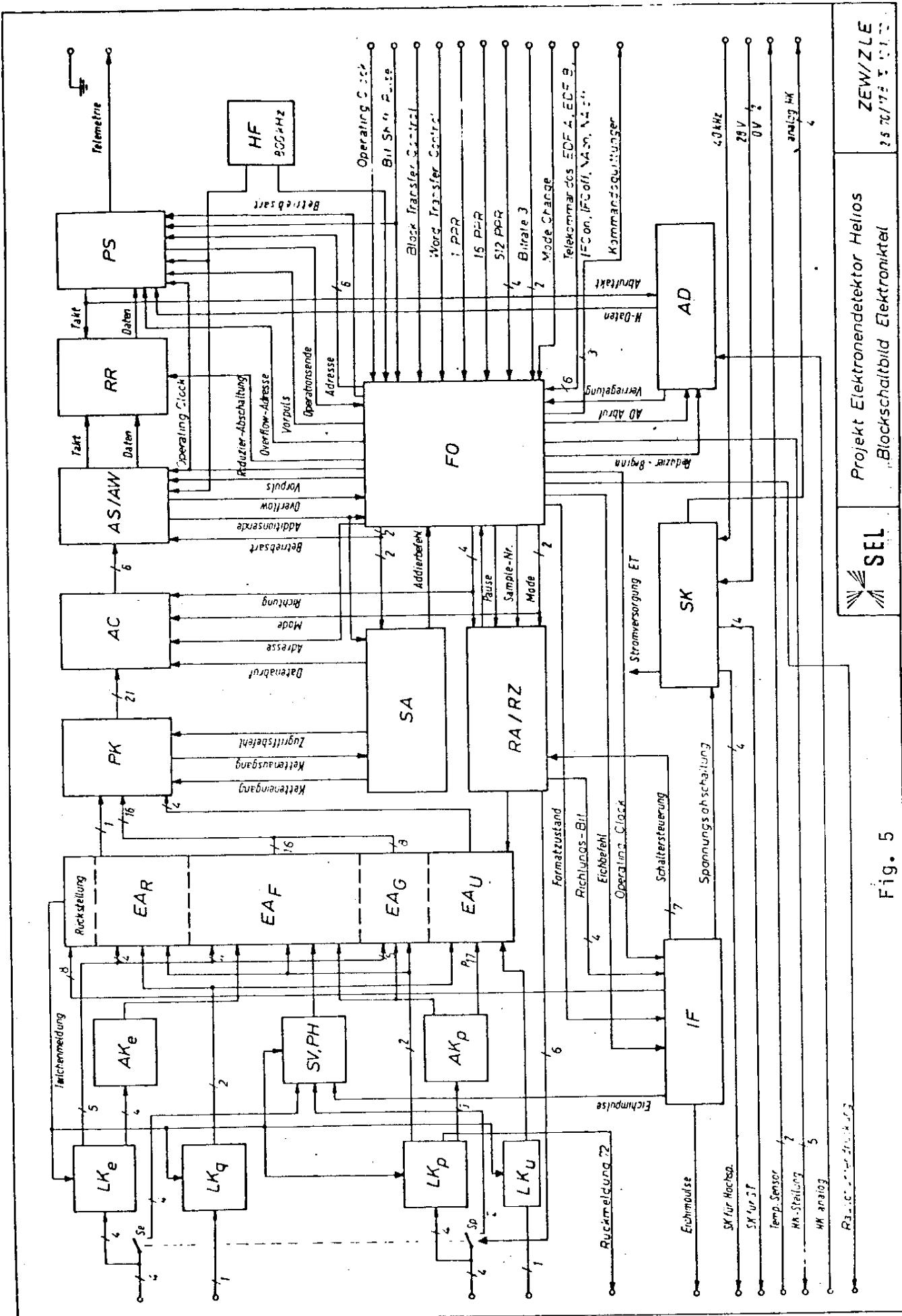


Fig. 5

SEL
Projekt Elektronendetektor Helios
Blockschatzbild Elektronikteil
ZEW/ZLE
25.7.1975

TABLE 4: MEASUREMENT CYCLE - MODE A.

| Iteration No. | 1 | 2 | 3 | 4 | ... | m | 1...m | 1...m | 1...m | 1...m | ... | ... | ... | ... | ... | ... | ... | ... |
|------------------------|----------------|----------------|---|---|---|----------------|---|---|--|---|---|----------------|---|---|--|----------------|-----|-----|
| Measuring Cycle No. | ← 1 → | | | | 2 | 3 | 4 | ... | 7 | 8 | 9 | 10 | 11 | ... | 15 | 16 | 17 | ... |
| Cycle | R _e | R _p | R _e | R _p | ... | R _e | R _p | R _e | R _p | R _e | R _p | R _e | R _p | R _e | R _p | R _e | ... | |
| Cycle | F _e | Sector 1,9 | F _e S ₁₀ ² | F _e S ₁₁ ³ | F _e S ₁₂ ⁴ | | F _e S ₁₅ ⁷ | F _e S ₁₆ ⁸ | F _p S ₉ ¹ | F _p S ₁₀ ² | F _p S ₁₁ ³ | | F _p S ₁₅ ⁷ | F _p S ₁₆ ⁸ | F _e S ₉ ¹ | ... | | |

In addition the positron data (2 words), background data (1 word) and proton coincidence rate (1 word) are being collected for the same time, without sectorization.

These data form a fixed scheme, which is transmitted to the ground. Added to these "science data" are housekeeping informations and experiment status informations (words designated by H and S). By this means a total of 60 words is formed, which is called 1 EDF (Experiment Data Frame) and this is specific for the Experiment Mode A, therefore it is called EDF-A.

4. DETERMINATION OF "m"

The number "m" of completed revolutions, which defines the measuring time, is determined during inflight calibration (IFC) and stored until the next IFC is performed in a memory within the experiment. By means of m the experiment is coupled to the S/C-telemetry system. All the rest of data collection has no direct interface with telemetry; it is only controlled by the sector pulses and the see-sun-pulse, delivered to the experiment by the S/C.

After an IFC cycle is initiated, the experiment counts the number of sector pulses appearing between three BTC-pulses. BTC-pulses (Block-Transfer-Pulse) are delivered from the S/C. The experiment is coupled to the S/C such, that following one BTC, 20 words are read out, so after 3 BTC's one EDF-A is being read out. So this time defines the interval between two requests of the S/C for data words. As in this time also data reduction has to be done, we have to provide a fixed time for that. Deadtime on the other hand should be kept small. Therefore we utilize the following scheme: The number of sector pulses ($T_0/8$) received during a telemetry cycle is reduced by a certain fixed number. The rest is devided by 8, and this number is called m, which is the largest integer multiple of spin periods within one telemetry cycle. How to determine m is shown in Fig. 4. Lower bitrates make m larger, which means our measuring time becomes larger. At very low bitrates, this would be unreasonably long, therefore we defined an experiment mode of operation, mode B, which produces only 20 words of information and allows shorter measuring time. This format is called EDF-B.

5. OPERATIONAL PRINCIPLES, MODE B

In this mode the counting rates of the discriminators, which monitor the analog data lines (Fig. 3) are being transmitted (rates of sensors 1, 2, 3, two rates of sensor 4, sectored rate of sensor 6 ($L \bar{H} \bar{B}$), and two rates of sensor 7 (protons)). Sectorization is being done in $T_0/8$ sectors (T_0 = spin period), and two sets of sectored data are transmitted in one frame (sector 1+4, 2+5, 3+6, 4+8). These data are called G-data. In addition status and housekeeping data are being transmitted. The energy ranges contained in these words correspond directly to those given in Table 1. Proton ranges are 21 - 137 keV (energy loss) and >137 keV. The measuring sequence is shown in Table 5.

TABLE 5: MEASUREMENT CYCLE - MODE B.

| Revolution No. | 1 2 3 ... m | 1...m | 1...m | 1...m | 1...m | ... |
|--------------------|----------------------------|-------|-------|-------|-------|-----|
| Measuring Cycle | $\leftarrow 1 \rightarrow$ | 2 | 3 | 4 | 5 | ... |
| Data Cycle Sectors | 1,5 | 2,6 | 3,7 | 4,8 | 1,5 | ... |

The experiment operates at the bitrates 2048, 1024, 512, 256 bps in Mode A automatically, and at all lower bitrates in Mode B. However, it may be commanded by sending a proper command to operate in Mode A at all bitrates, and also in Mode B at 512 and 1024 bps. Mode B at 2048 will result in not usable data.

6. INFLIGHT CALIBRATION

For inflight calibration purposes a pulsetrain with exponentially falling amplitude is applied to all amplifier chains in parallel. Specific ones are selected through properly commanding the analog switches (Fig. 3). Three specific objectives are met by IFC: (a) all thresholds of the PHA are checked; (b) amplification of electron and proton channels are tested using one and the same PHA-threshold; (c) m is determined. The data pattern is shown in Fig. 10 and 11. (There is a scheme valid for EDF-A and one for EDF-B.) The way, how m is to be determined, is shown in Fig. 12. See also Fig. 5.

7. DATA FRAMES

The normal data frame is shown in Fig. 6 for EDF-A, and in Fig. 7 for EDF-B.

FIG. 6: EDF-A-WORDS.

| | | | | | | | |
|-----------|-----------|-----------|-----------|------------------|------------------|-------|-------------------|
| 1 H-1 | 2 S-1 | 3 H-2 | 4 B | 5 F_{PHA1} | 6 F_{PHA2} | | 20 F_{PHA16} |
| 21 H-1 | 22 S-2 | 23 Q-2 | 24 Q-1 | 25 F_{PHA1} | 26 F_{PHA2} | | 40 F_{PHA16} |
| 41 H-1 | 42 S-3 | 43 0 | 44 K | 45 R_{S1} | 46 R_{S2} | | 60 R_{S16} |
| 1 H-1 | 2 S-1 | 3 H-2 | 4 B | 5 F_{PHA1} | 6 F_{PHA2} | | 20 F_{PHA16} |
| : | : | : | : | : | : | : | : |

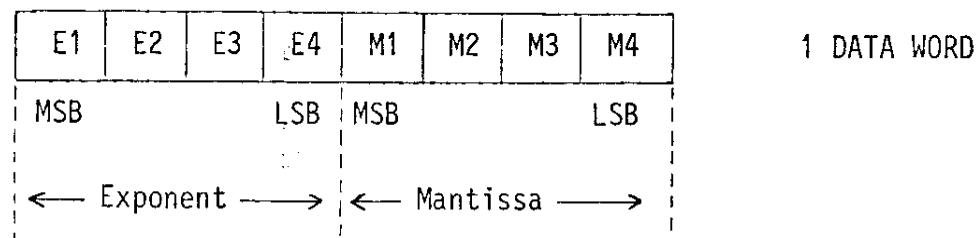
FIG. 7: EDF-B-WORDS.

| | | | | | | | |
|----------|--------|----------|--------|--------|--------|-------|---------|
| 1 H-1 | 2 0 | 3 H-2 | 4 B | 5 G | 6 G | | 20 G |
|----------|--------|----------|--------|--------|--------|-------|---------|

All data to the left of the dashed line in Fig. 5 and 6 are normal 8 bit words, all data to the right are quasilogarithmically compressed. The quasilogarithmical compression scheme is illustrated in Fig. 8.

FIG. 8: QUASILOG. COMPRESSION SCHEME

Bit No. 1 2 3 4 5 6 7 8



Leading 1 being suppressed. After decoding mantissa reads $M_0 M_1 M_2 M_3 M_4$, where $M_0 = 0$, if $E_1 = E_2 = E_3 = E_4 = 0$.

Original Data Word:

| Bit No. | 0 | 1 | 2 | 3 | | n-1 | n | n+1 | | 16 | 17 | 18 |
|---------|----------|----------|----------|----------|-------|-----------|-------|-----------|-------|-------|-------|-------|
| Design | w_{18} | w_{17} | w_{16} | w_{15} | | w_{n+1} | w_n | w_{n-1} | . | w_2 | w_1 | w_0 |
| Binary | X | X | X | X | | X | 1 | 0 | | 0 | 0 | 0 |

$0 \leq n \leq 18$; X any value.

- a.) $4 \leq n \leq 18$: $E_1 \dots E_4$ is inverted dual number of $(n-4)$; mantissa $M_1 \dots M_4$ corresponds to $(w_{n-1}, \dots w_{n-4})$.
- b.) $0 \leq n \leq 3$: $(E_1 \dots E_4) = (0 \dots 0)$; mantissa corresponds to w_3, w_2, w_1, w_0 .

7.1 EDF-A

In Fig. 6 word 5 to 20 contain F-data from sector X ($1 \leq X \leq 8$), word 25 to 40 from sector X+8, F-data being either electron or proton data, as indicated by word 1 (see below). Word 45 to 60 contain R-data from sector 1 to 16, being either electron or proton energy integral information as indicated by word 1 (see below).

Word 4 is the background information (sensor 9, Fig. 3), which is not sectorized. Word 23 and 24 contain the information H and L \bar{H} \bar{B} respectively (see section 2). Also these data are not sectorized. Word 44 contains the coincidence rate (S7 S8), not sectorized. So to determine the counting rate corresponding to word 5-20, 25-40, 45-60

$$N = \frac{W \cdot 16}{m \cdot T_0} \text{ counts/sec , where } T_0 = \text{spin period, } W = \text{contents;}$$

of one of these words. For word 4, 23, 24, 44 we have $N = \frac{W}{m \cdot T_0}$.

Word 3 is the housekeeping word H-2 (see section 7). H-1 and S-1, S-2, S-3 words are experiment status information words. Fig. 9 shows their meaning.

FIG. 9: INTERPRETATION OF H-1 AND S-WORD (BIT 1 = FIRST BIT SHIFTED).

| H-1 - Bits | | S - Bits |
|--------------------|-----------------|-------------------|
| Interpretation | 1 2 3 4 5 6 7 8 | Interpretation |
| Format A | 1 | S: Word No. 2 |
| Format B | 0 | Word No. 22 |
| EDF-counter | X X X X | Word No. 42 |
| NA-ON (EDF-B only) | 1 | No Overflow |
| NA-OFF " " " | 0 | Overflow in W5-20 |
| F-Data Electrons | 0 | " " " W25-40 |
| F-Data Protons | 1 | " " " W45-60 |
| R-Data Electrons | | Overfl.in W4,23, |
| R-Data Protons | 0 | 24,44 |
| | 1 | 1 0 |
| Reset EDF | | NA-ON |
| X-EDF | | NA-OFF |
| Normal Data | | 1 0 0 0 |
| Overflow X-EDF | | Fixed |
| No Overflow | | 1 0 |

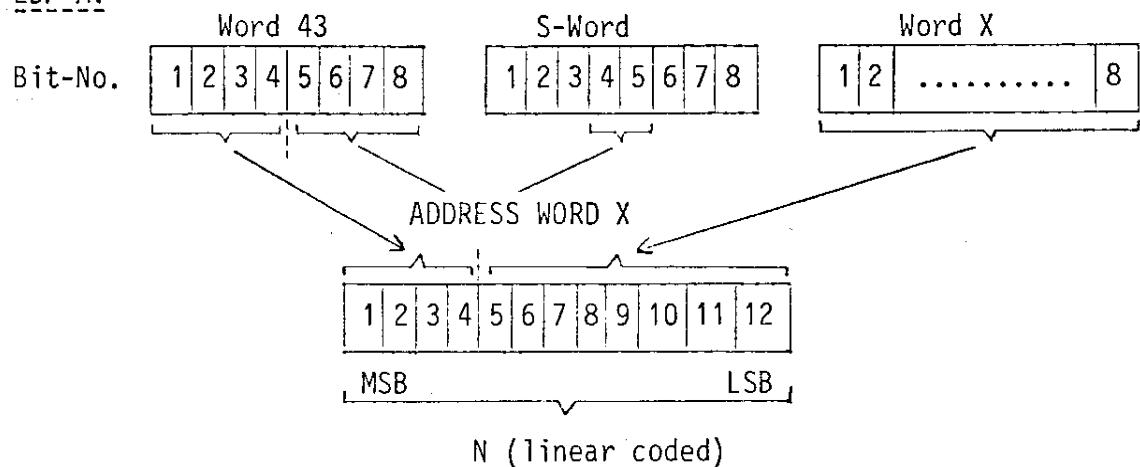
So from the words H-1 and S everything on the experiment status is known.

7.2 OVERFLOW

Word 43 is called 0-word and is used for overflow information. In case of low bitrates overflow may occur. So all data words have this precaution. If a particular channel shows overflow, counting is stopped in all channels. That channel showing overflow is used to count from thereon until end of measuring time (determined by m) $T_0/8$ -sector pulses. The address of the particular channel showing overflow is contained in word 43. Whether this is in word 5-20, 25-40, 45-60 or in W4, 23,24,44, is indicated by bits 3 and 4 of the S-word (see Fig. 9). Details are shown in Fig. 10.

FIG. 10: OVERFLOW EVALUATION.

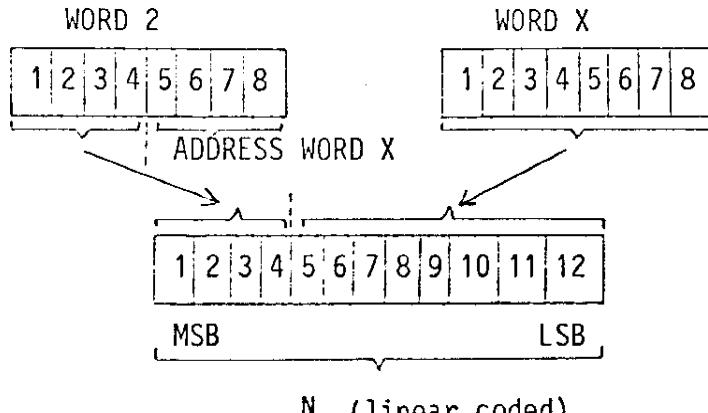
EDF-A:



Elapsed time T from overflow occurrence to end of measuring time

$$T = N \cdot \frac{T_0}{8} \quad (T_0: \text{spin period})$$

EDF-B:



$$\text{Elapsed time } T = N \cdot T_0/8 \quad (T_0: \text{spin period})$$

7.3 EDF-B

Words 5 to 20 contain the science data, utilizing the following scheme:

| Word | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------|----|----|----|------|------|------|------|----|-----|-----|-----|------|------|------|------|-----|
| Channel | S1 | S2 | S3 | S4.1 | S4.2 | S7.1 | S7.2 | S6 | S1 | S2 | S3 | S4.1 | S4.2 | S7.1 | S7.2 | S6 |
| Sector | X | X | X | X | X | X | X | X | X+4 | X+4 | X+4 | X+4 | X+4 | X+4 | X+4 | X+4 |

(Sector number is contained in bit 2-5 of the H-1 word (word 1). Word 2 contains the overflow information (see Fig. 9), word 3 contains housekeeping data (see below), word 4 contains the counting rate of the background detector S9 (not sectorized). The counting rate is obtained from the data by

$$N = \frac{W \cdot 8}{m \cdot T_0} \quad (\text{word 5-20})$$

$$N = \frac{W}{m \cdot T_0} \quad (\text{word 4}).$$

7.4 INFLIGHT CALIBRATION FRAMES

Fig. 11 shows the scheme how inflight calibration frames are structured in EDF-A, Fig. 12 shows this for EDF-B. Fig. 12 illustrates how m is to be determined from the information, contained in the IFC-Data-Frame (= X-EDF).

FIG. 11: INFLIGHT CALIBRATION FRAME IN EDF-A.

| | | | | | | | | | | | | | |
|-----------|---------------|---------------------|-------------|---------------------------------|-------------------------------|-------------------------------|---|--------------------------------|----------------------------------|--------------------------------|--------------------------------|------------------|---------------------------|
| 1 373 | 2 0_7^6 | 3 HK 15 HK 16 | 4 S9 | W5-W9 PHA1-5 Sensor 1 | W10-W13 PHA1-4 Sensor 2 | W14-W17 PHA1-4 Sensor 3 | W18-W20 PHA1-PHA4 Sensor 4 | | | | | | |
| 21 373 | 22 1_7^6 | 23 | 24 S 6.2 | W25-W27 PHA1-3 Sensor 7.1 | W28-W30 PHA1-3 direct | W31-W32 --- | W33-W35 PHA1-PHA3 Sensor 7.2 direct | | | | | | |
| 41 373 | 42 2_7^6 | 43 013 | 44 K | W45 In- te- gral S1 | W46 Int. S2 | W47 Int. S3 | W48 Int. S4 | W49 50 \emptyset S7 | W51 Int. \emptyset S7 | W52 53 \emptyset S7 | W55 54 \emptyset S7 | W56 m S7 | W57- 60 \emptyset |

Information in W1, 2, 3, 21, 22, 41, 42, 43 noted in octal form.

FIG. 12: INFLIGHT CALIBRATION FRAME IN EDF-B.

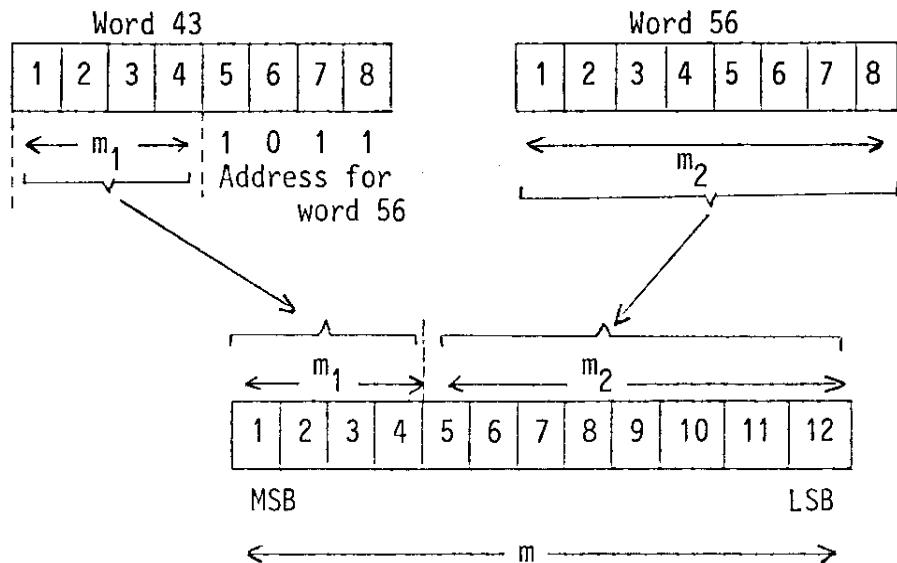
| | | | | | | | | | | | | | | |
|----------|--------------|-------------------|---------|--------------------------|--------------------------|--------------------------|----------------------------|----------------------------|----------------------|-----------|-------------------|-----------------------------|-----------------------------|---------------------------|
| 1 173 | 2 0_3^1 | 3 HK15 HK16 | 4 S9 | 5 Inte- gral S1 | 6 Inte- gral S2 | 7 Inte- gral S3 | 8 Inte- gral S4.1 | 9 Inte- gral S4.2 | 10-15 \emptyset | 16 m | 17 \emptyset | 18 Inte- gral S7.1 | 19 Inte- gral S7.2 | 20 Inte- gral S6 |
|----------|--------------|-------------------|---------|--------------------------|--------------------------|--------------------------|----------------------------|----------------------------|----------------------|-----------|-------------------|-----------------------------|-----------------------------|---------------------------|

Informations in words 1 and 2 are noted in octal form.

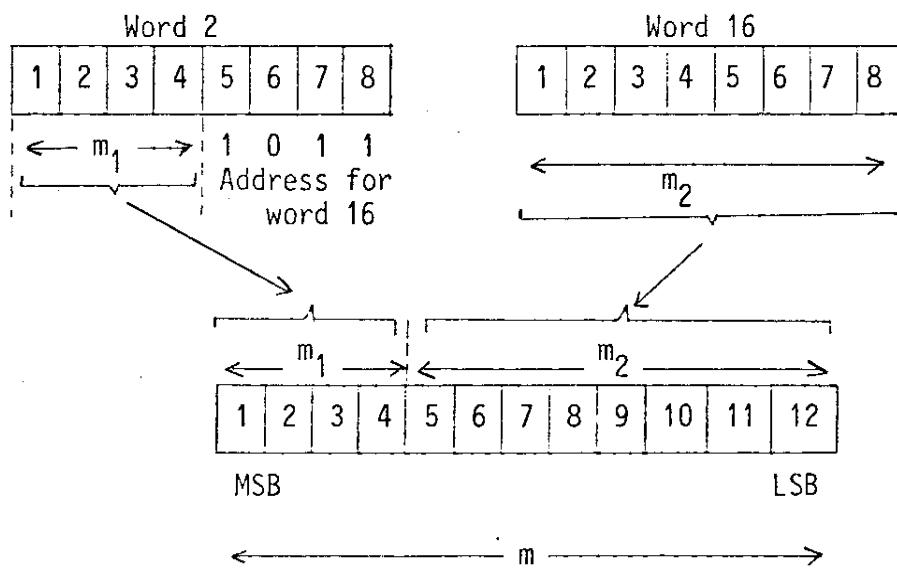
The values of the H- and S-words in Fig. 11 and 12 are given in octal numbers as they are fixed. Word 3 in Fig. 11 and 12 contain housekeeping values as described below. The values of the data words are temperature dependent, therefore for validity check special tables have to be used. Also for determination of relevant information from the X-EDF's the experimenter should be contacted.

FIG. 13: EVALUATION OF m . (see also S-word, section 7.1).

EDF-A:



EDF-B:



$$\text{Measuring period} = m \cdot T_0 \quad (T_0: \text{spin period})$$

8. HOUSEKEEPING AND ENGINEERING DATA

The experiment produces housekeeping data (A/D converted within the experiment) and engineering data (analog delivered to the S/C).

The following data are housekeeping data channels, included in word 3 (EDF-A and B) of the experiment data frame:

| | |
|-----------------|-----------------------------------|
| 0 Signal Ground | 8 Noise S2 |
| 1 Noise S6 | 9 Temperature Analog Electronic |
| 2 Noise S7 | 10 Temperature Sensor System |
| 3 Noise S8 | 11 Signal Ground |
| 4 Noise S3 | 12 + 5 V Internal Supply Voltage |
| 5 Noise S4 | 13 + 12 V Internal Supply Voltage |
| 6 Noise S9 | 14 - 6 V Internal Supply Voltage |
| 7 Noise S1 | 15 Test Input |

They are 4 bit coded, two of them are combined to form word 3 (= 8 bit, bit 1-4 and bit 5-8). The number of the first channel contained in a particular EDF is indicated by bit 3-5, word 1 (H-word). The second channel is always that with the subsequent number. All data are in mV. Calibration curves are available on request. The following engineering data are contained in the engineering format of the S/C (8 bit coded). The list includes other engineering data containing relevant other informations.

ENGINEERING DATA - E8

| Designation | MBB Acronyms | Meaning | Calibration |
|------------------------|--------------|--|---------------------------------|
| D 080 | TEE 801 | TD 28 AT | Temperature Sensor Box E8A |
| D 081 | TEE 802 | TD 28 BT | Temperature Electronic Box E8B |
| C 036 | ASE 8V4+ | TE8V4 | Temperature Electricnic Box E8C |
| C 037 | ASE 8C4+ | TE8C4 | Current on 28 V line |
| A-000/0 | DPE8A4 | "L": EDF-A ON "H": EDF-B ON | $I_{28} = 0,0676 \frac{mA}{V}$ |
| A-000/1 | DPE8B4 | "L": IFC-CYCLE "H": NORMAL CYCLE | HK(I28) [V] |
| A-000/2 | DPE8C4 | "L": S1 ON "H": S1 OFF | |
| B-003/5 | E8PWR | "L": E8 POWER OFF "H": E8 POWER ON | |
| D-040/4 | NEBUS | "H": NON ESSENTIAL BUS ON | |
| D-000/0-7 D-001/0-3 | SPNRPM | SPIN PERIOD | |
| D-121 | E8ELOU | E8-C-Temperature (SKIN) | |
| D-124 | E8SOUT | E8-A-Temperature (Sensor SKIN) | |
| B-007/5 | SECPUS | Normal or redundant sector pulse generator | 1 Redundant 0 Normal |
| D-001/7 | SECGEN | Sectoring pulse generation | 1 Yes, 0 NO |
| D-038 | ECU-RH | Calibration of A/D-converter | |
| C-009 | SUN C9A | Angle MFP1 and See-Sun-Pulse | |
| C-009 | MFP 1SA | Angle MFP 1 and See-Sun-Pulse | |

9. COMMANDS

The experiment may be commanded into different modes by utilizing the following commands:

| Octal Address | MBB Acronym | Meaning |
|---------------|-------------|------------------------|
| 120 | 8NON | S1 ON |
| 131 | E8ON | E8 POWER ON |
| 141 | 8COF | E8 IFC OFF |
| 162 | 8DFB | E8 EDF-B ON |
| 215 | 8DFA | E8 EDF-A ON |
| 236 | 8CON | E8 IFC ON |
| 214 | E8OF | E8 POWER OFF |
| 257 | 8N0F | S1 OFF |
| 036 | NLON | NON ESSENTIAL LOAD ON |
| 164 | NLOF | NON ESSENTIAL LOAD OFF |
| 341 | NLOR | NON ESSENTIAL LOADS ON |

74-097A-10A DE/DSR 4590

RECORD LENGTH = 1 OF FILE BYTES 1

Table I:
 12/10/74 - 3/3/75
 4/1/75 -
 1/1/79 -
 3/13/79
 6/2/80 -
 4/1/80 -
 14/3/80 -

RECORD LENGTH = 2421 OF FILE 1
= 4464 BYTES

RECORD LENGTH = 1 OF FILE 4464 BYTES 2

DUMP OF TAPE BRI

HELLOS - 1

521/13/2010

(2320) 0000J0006 405A8F5C J00000000 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C
 (2360) - 423146E79- 405A8F5C - 421F156D - 405A8F5C - 421C44C0 - 405A8F5C 41873064 405A8F5C 000-0000 405A8F5C
 (2440) - 412D3ACD - 405A8F5C 30J00000 - 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C 000-0000 405A8F5C
 (2480) 0000000 405A8F5C 42410405 405A8F5C 42385D2C 405A8F5C 4221EC19 405A8F5C 421F156D 405A8F5C
 (2520) 41E225FE 405A8F5C 415A7529 405A8F5C 4137B064 405A8F5C 4112D3ACD 405A8F5C 30000000 405A8F5C
 (2560) 415A7599 405A8F5C 41203ACD 405A8F5C 30000000 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (2600) - 60000000 405A8F5C 40000000 405A8F5C 40000000 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (2640) - 4213C939 405A8F5C 42197113 405A8F5C 42197373 405A8F5C 4210F60D 405A8F5C 42169D66 405A8F5C
 (2680) - 415A7592 405A8F5C 4134EB32 405A8F5C 41873064 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (2720) 0000000 405A8F5C 0000000 405A8F5C 41873064 405A8F5C 41203ACD 405A8F5C 42300E79 405A8F5C
 (2760) 421C44C0 405A8F5C 415A7599 405A8F5C 4137B063 405A8F5C 41203ACD 405A8F5C 415A7599 405A8F5C
 (2800) 41E225FE 405A8F5C 4213C939 405A8F5C 42248F6C 405A8F5C 42169D66 405A8F5C 42169D66 405A8F5C
 (2840) 41E225FE 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (2880) - 422A6720 405A8F5C 422749373 405A8F5C 42169D66 405A8F5C 4210F60D 405A8F5C 42169D66 405A8F5C
 (2920) - 41E225FE 405A8F5C 41873064 405A8F5C 41873064 405A8F5C 4184E332 405A8F5C 4235b503 405A8F5C
 (2960) 0000000 405A8F5C 0000000 405A8F5C 41873064 405A8F5C 41203ACD 405A8F5C 42197113 405A8F5C
 (3000) 422D3ACD 405A8F5C 42197113 405A8F5C 41203ACD 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (3040) 41E225FE 405A8F5C 4187B064 405A8F5C 4213C939 405A8F5C 4213C939 405A8F5C 4213C939 405A8F5C
 (3080) - 4182H064 405A8F5C 4213C939 405A8F5C 42497E8C 405A8F5C 42497E8C 405A8F5C 42497E8C 405A8F5C
 (3120) 0000000 405A8F5C 423E30D9 405A8F5C 42300E79 405A8F5C 421F186D 405A8F5C 421F186D 405A8F5C
 (3160) 4210F60D 405A8F5C 41E225FE 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 415A7599 405A8F5C
 (3200) 412D3ACD 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 40000000 405A8F5C 40000000 405A8F5C
 (3240) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3280) 4221EC19 405A8F5C 41E225FE 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (3320) 41D23ACD 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3360) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3400) 415A7599 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3440) 415A7599 405A8F5C 4187B064 405A8F5C 415A7599 405A8F5C 41203ACD 405A8F5C 415A7599 405A8F5C
 (3480) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3520) 4221EC19 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (3560) 41D23ACD 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (3600) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3640) 4232E226 405A8F5C 422A6720 405A8F5C 4213C939 405A8F5C 4184EB32 405A8F5C 4184EB32 405A8F5C
 (3680) 4137B064 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (3720) 41E225FE 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (3760) 0000000 405A8F5C 42279373 405A8F5C 4184EB32 405A8F5C 4184EB32 405A8F5C 4184EB32 405A8F5C
 (3800) 41B4EB32 405A8F5C 421C44C0 405A8F5C 421C44C0 405A8F5C 4213C939 405A8F5C 4213C939 405A8F5C
 (3840) 41B4EB32 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 4210F60D 405A8F5C 4210F60D 405A8F5C
 (3880) 0003J0000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (3920) 415A7599 405A8F5C 415A7599 405A8F5C 415A7599 405A8F5C 41203ACD 405A8F5C 415A7599 405A8F5C
 (3960) 41E225FE 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 41203ACD 405A8F5C 4187B064 405A8F5C
 (4000) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (4040) 41E4EB32 405A8F5C 4187B064 405A8F5C 4187B064 405A8F5C 4210F60D 405A8F5C 4210F60D 405A8F5C
 (4080) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (4120) 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C 0000000 405A8F5C
 (4160) 42355F1 414F30D6 421D1385 414F30D6 421D1385 414F30D6 421D1385 414F30D6 421D1385 414F30D6
 (4200) 421E7D53 414F30D6 421E7D53 414F30D6 421E7D53 414F30D6 421D1385 414F30D6 421D1385 414F30D6
 (4240) 421BDD5F 414F30D6 421E7D53 414F30D6 421E7D53 414F30D6 421D1385 414F30D6 421D1385 414F30D6
 (4280) 4252BFF2 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285
 (4320) 42E6468F2 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285
 (4360) 42C53CF76 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285
 (4400) 423BEDEA 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285 427C6184 41354285
 (4440) 40001F20 3D047J000 40001F20 3D047J000 40001F20 3D047J000 40001F20 3D047J000 40001F20